

## UNDERSTANDING SLOPES OF PARALLEL AND PERPENDICULAR LINES

**OBJECTIVE:** After completing this activity which includes 2 learning stations and 1 reinforcing "game" station, the students will understand that slopes of parallel lines are equal and slopes of perpendicular lines are opposite reciprocals.

- Previous knowledge needed:
  - Slope formula
  - Writing equations of lines in slope-intercept form when given two points
  - Basic concept of what the graphs of parallel and perpendicular lines look like
- Intended Audience: 8<sup>th</sup> grade or Algebra 1
- High School Common Core State Standards
  - ♦ Conceptual Category: Geometry
    - Domain: Expressing Geometric Properties with Equations
      - Cluster: Use coordinates to prove simple geometric theorems algebraically
        - Standard: #5 - Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems.
  - ♦ Conceptual Category: Algebra
    - Domain: Reasoning with Equations and Inequalities
      - Cluster: Solve systems of equations
        - Standard: #6 - Solve systems of linear equations exactly and approximately, focusing on pairs of linear equations in two variables.
          - (Although we are not solving systems, this will let them see that in a system that has parallel lines, there will be no solution because there is no point of intersection.)
- Materials
  - Students will need a basic set of colored pencils, rulers and a calculator
  - Copies of parallel activity worksheets for each student
  - Copies of perpendicular activity worksheets for each student
  - Several sets of "memory" cards
- Procedure
  1. Put students in groups of four
  2. Have half of the groups work on the activity worksheets that involve perpendicular lines and the other half work on the activity worksheets that involve parallel lines
  3. Students will work on these activity worksheets in their groups for 15 minutes and then switch activity groups and complete the other set of activity worksheets for 15 minutes
  4. After both sets of worksheets have been completed by all groups, have the groups compete against each other in a game of memory with the cards that contain graphs of equations that are parallel or perpendicular to each other and equations that are parallel or perpendicular to each other.

Algebra 1  
Parallel Lines Investigation

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Mod: \_\_\_\_\_

Directions: Graph the points and use a ruler to draw the line that passes through them. Use the designated color to draw each line.

RED:  $(-3, 2)$   $(0, 4)$

BROWN:  $(-5, -1)$   $(5, -5)$

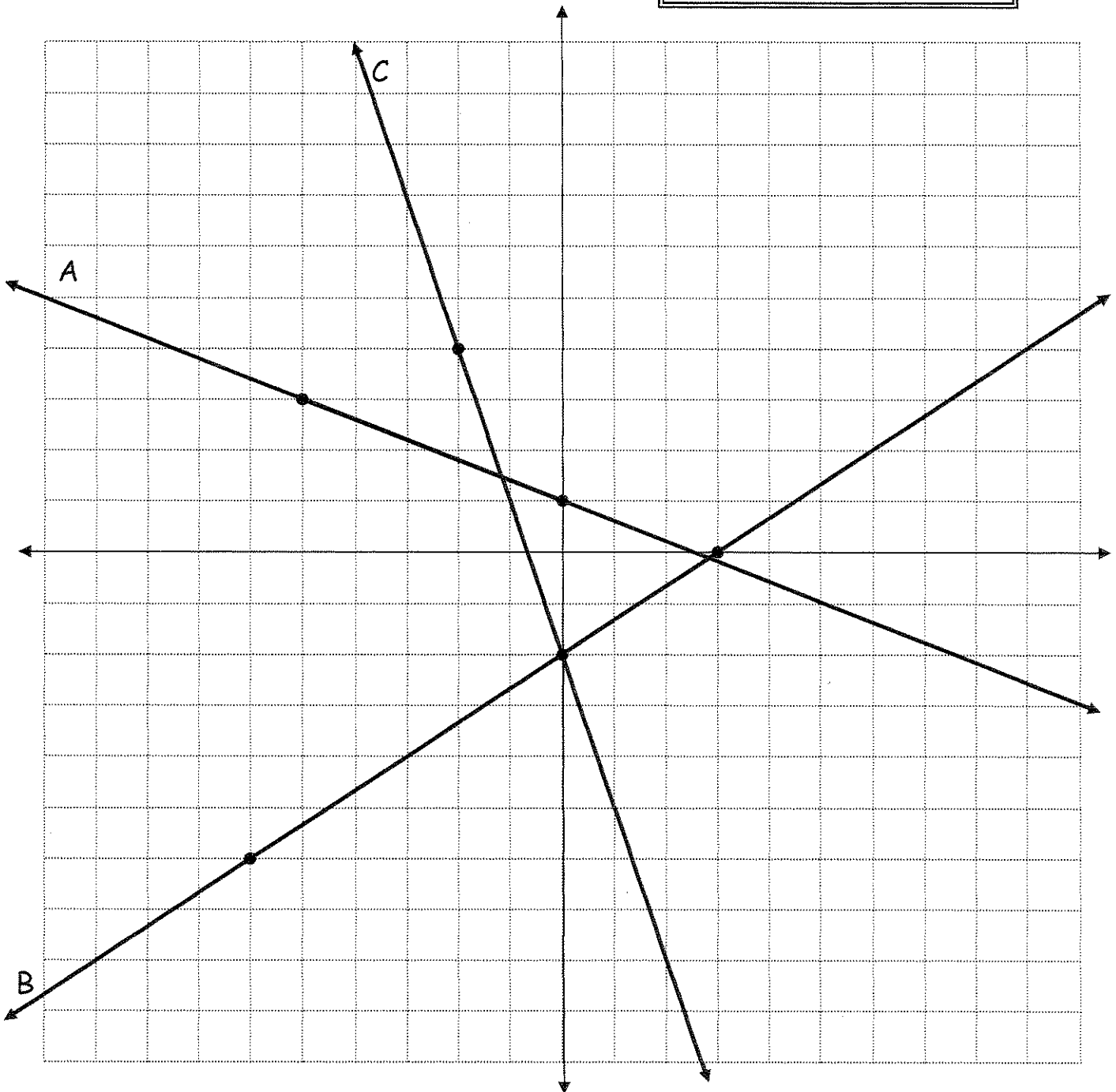
GREEN:  $(1, 1)$   $(2, -2)$

Given Lines and Their Points

A:  $(0, 1)$   $(-5, 3)$

B:  $(3, 0)$   $(-6, -6)$

C:  $(-2, 4)$   $(0, -2)$



## Algebra 1

### Parallel Lines Investigation

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Mod: \_\_\_\_\_

The equation of Line A is  $y = -\frac{2}{5}x + 1$ .

The equation of Line B is  $y = \frac{2}{3}x - 2$ .

The equation of line C is  $y = -3x - 2$ .

**Directions:** Use the points given to write the equation of each line in slope-intercept form.

RED LINE	BROWN LINE	GREEN LINE

**Directions:** Use your graph to help answer the following questions.

1. Which colored line is parallel to line A? \_\_\_\_\_

What are the equations of these 2 lines?

2. Which colored line is parallel to line B? \_\_\_\_\_

What are the equations of these 2 lines?

3. Which colored line is parallel to line C? \_\_\_\_\_

What are the equations of these 2 lines?

Algebra 1  
Parallel Lines Investigation

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Mod: \_\_\_\_\_

**Directions:** Use the equations of each pair of parallel lines to answer the following questions.

4. What do you notice about the slopes in each pair of equations?
  
  
  
  
  
5. What do you notice about the y-intercepts of in each pair of equations?
  
  
  
  
  
6. What general statement can you make about the equations of parallel lines in relation to  $y = mx + b$  ?

**Directions:** Answer the following the questions using the knowledge you gained from your investigation.

1. Are  $y = 3x + 7$  and  $y = 3x - 8$  parallel to each other? YES or NO
2. Are  $y = \frac{2}{3}x - 2$  and  $y = \frac{3}{2}x + 1$  parallel to each other? YES or NO
3. Name 3 lines that are parallel to  $y = 2x - 3$ .
  
  
  
  
  
4. Name 3 lines that are not parallel to  $y = 5x - 2$ .

Algebra 1  
Perpendicular Lines Investigation

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Mod: \_\_\_\_\_

Directions: Graph the points and use a ruler to draw the line that passes through them. Use the designated color to draw each line.

BLUE: (0, 2) (2, -1)

PURPLE: (-3, 6) (-6, 5)

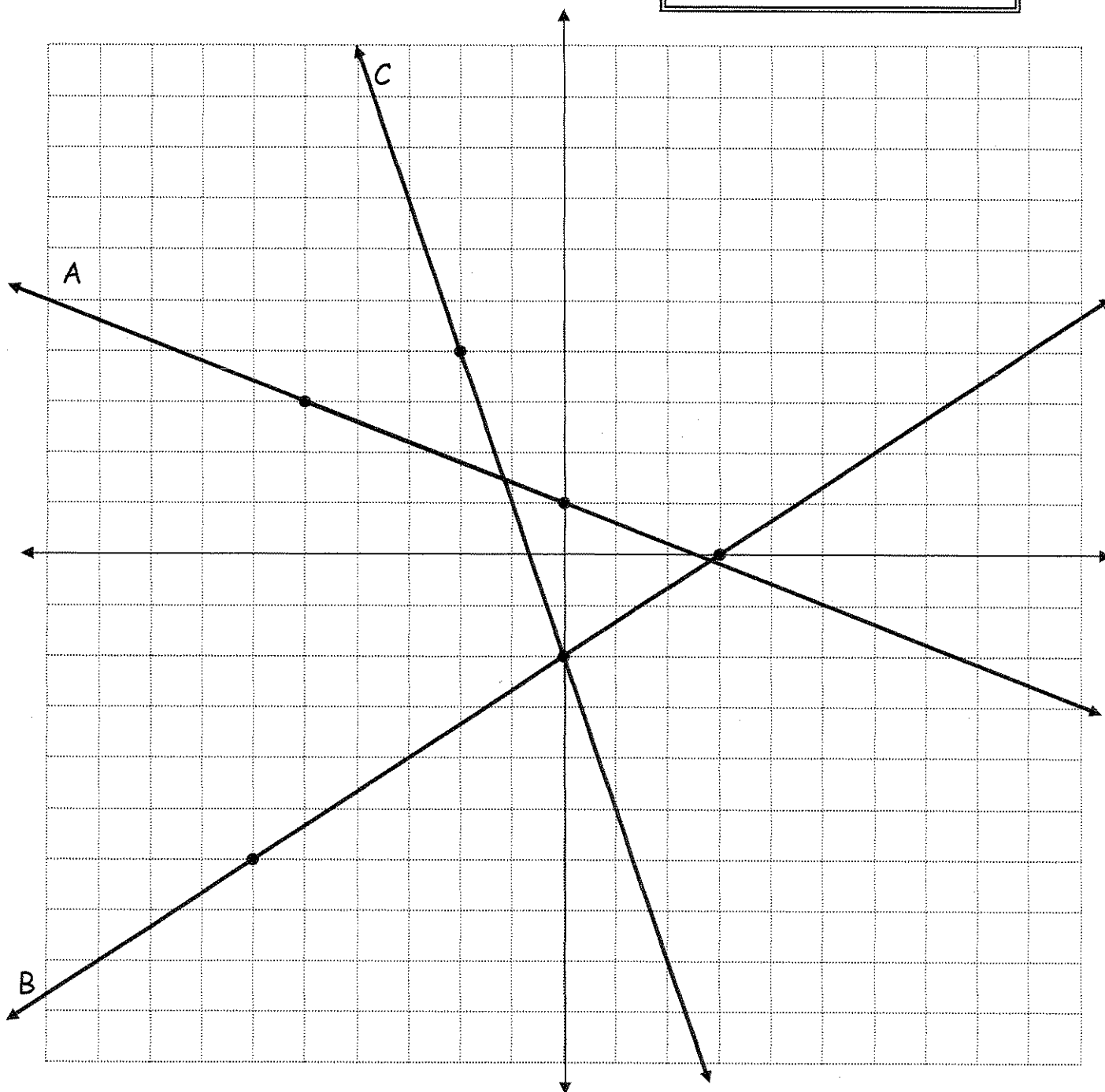
ORANGE: (4, 0) (6, 5)

Given Lines and Their Points

A: (0, 1) (-5, 3)

B: (3, 0) (-6, -6)

C: (-2, 4) (0, -2)



## Algebra 1

### Perpendicular Lines Investigation

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Mod: \_\_\_\_\_

The equation of Line A is  $y = -\frac{2}{5}x + 1$ .

The equation of Line B is  $y = \frac{2}{3}x - 2$ .

The equation of line  $C$  is  $y = -3x - 2$ .

**Directions:** Use the points given to write the equation of each line in slope-intercept form.

BLUE LINE	PURPLE LINE	ORANGE LINE

**Directions:** Use your graph to help answer the following questions.

1. Which colored line is perpendicular to line A? \_\_\_\_\_

What are the equations of these 2 lines?

2. Which colored line is perpendicular to line B? \_\_\_\_\_

What are the equations of these 2 lines?

3. Which colored line is perpendicular to line  $C$ ? \_\_\_\_\_

What are the equations of these 2 lines?

Algebra 1  
Perpendicular Lines Investigation

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Mod: \_\_\_\_\_

**Directions:** Use the equations of each pair of perpendicular lines to answer the following questions.

4. What do you notice about the slopes in each pair of equations?
  
  
  
  
  
  
  
  
  
  
5. What do you notice about the y-intercepts of in each pair of equations?
  
  
  
  
  
  
  
  
  
  
6. What general statement can you make about the equations of perpendicular lines in relation to  $y = mx + b$ ?

**Directions:** Answer the following the questions using the knowledge you gained from your investigation.

1. Are  $y = 3x + 7$  and  $y = 3x - 8$  perpendicular to each other? YES or NO
2. Are  $y = \frac{2}{3}x - 2$  and  $y = -\frac{3}{2}x + 1$  perpendicular to each other? YES or NO
3. Name 3 lines that are perpendicular to  $y = 2x - 3$ .
  
  
  
  
  
  
  
  
  
  
4. Name 3 lines that are not perpendicular to  $y = 5x - 2$ .

# Matching Game

## Slopes of Parallel and Perpendicular Lines

**It's time to test your knowledge!**

Your Mission: Be the team to make the most matches.

**Directions:** Use your knowledge of how to play MEMORY.

Shuffle the 30 cards and place them face down in a grid pattern.

Play should alternate players from each team.

(Team A Person 1, then Team B Person 1, then Team A Person 2, then Team B Person 2, etc)

Only one chance to make a match is allowed per turn.

If you make a match, your turn is over and it is the next person's turn.

If you fail to make a match, your turn is over and it is the next person's turn.

Each card can be paired with exactly one card.

Equations will be paired with equations and graphs will be paired with graphs.

A match will either be

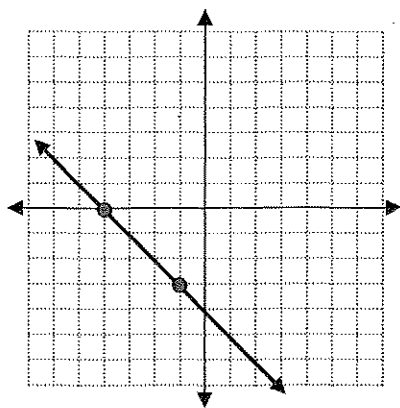
a set of equations that are parallel,

a set of equations that are perpendicular,

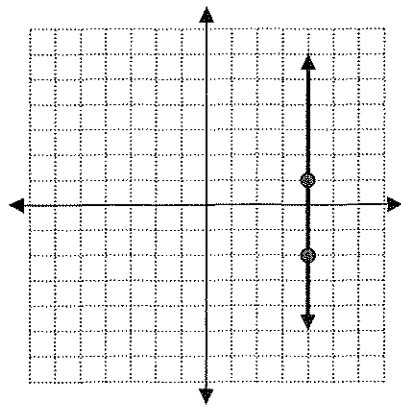
a set of graphs that are parallel,

or a set of graphs that are perpendicular.



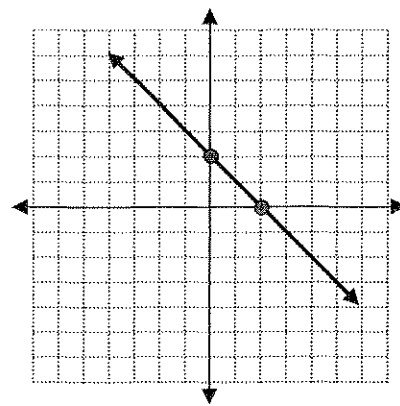


Slope = -1

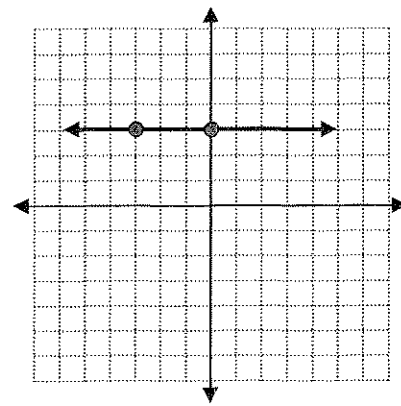


Slope = undefined

$$y = 2x + 7$$

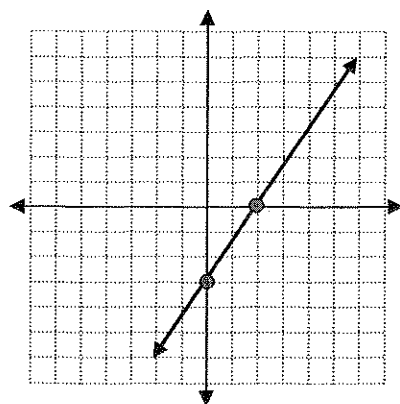


Slope = -1

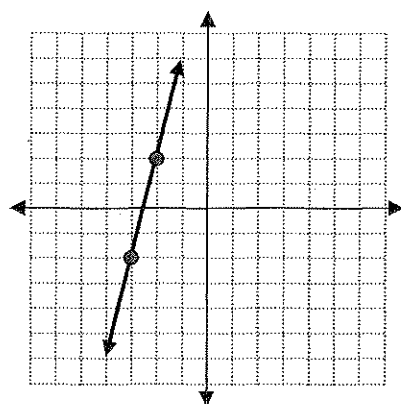


Slope = 0

$$y = 2x - 3$$

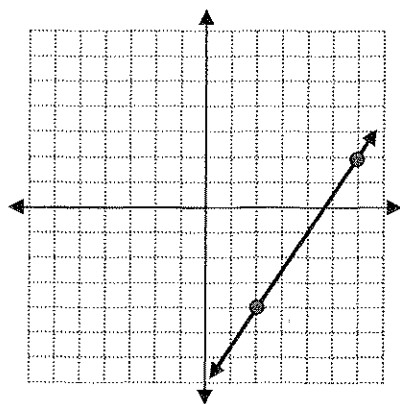


$$\text{Slope} = \frac{3}{2}$$

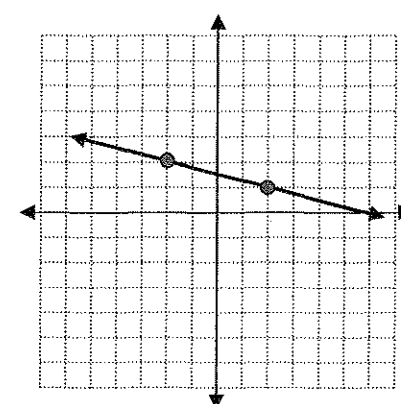


$$\text{Slope} = 4$$

$$y = 3x + 2$$

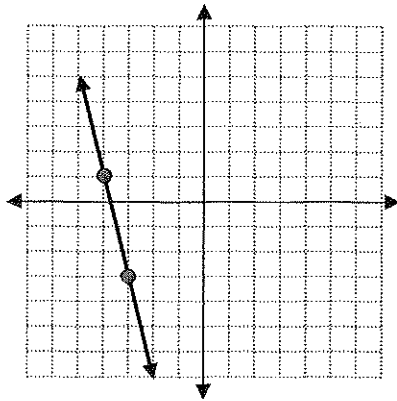


$$\text{Slope} = \frac{3}{2}$$

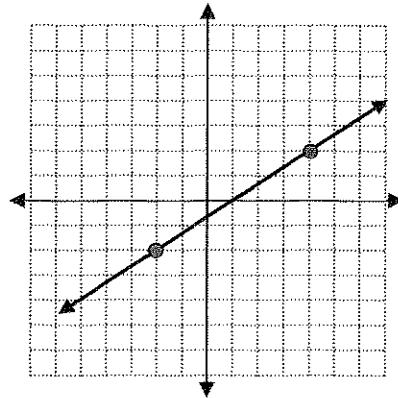


$$\text{Slope} = -\frac{1}{4}$$

$$y = -\frac{1}{3}x - 7$$

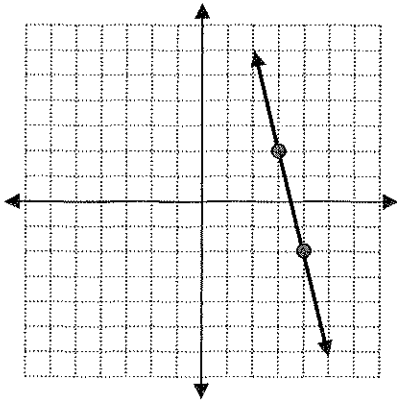


Slope =  $-4$

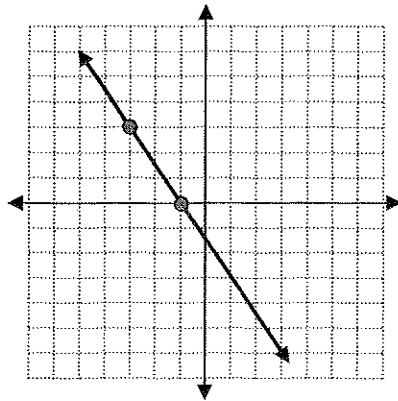


Slope =  $\frac{2}{3}$

$$y = \frac{2}{5}x + 3$$

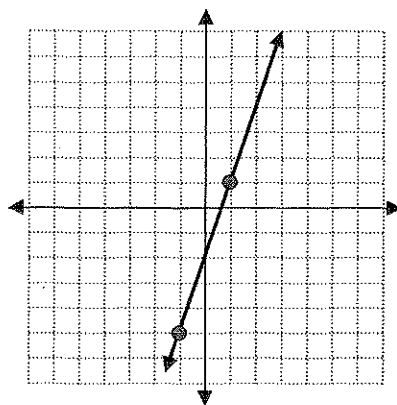


Slope =  $-4$

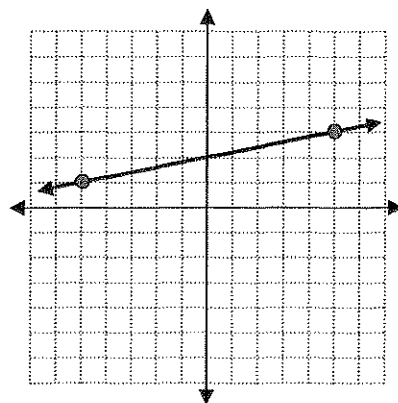


Slope =  $-\frac{3}{2}$

$$y = \frac{2}{5}x + 9$$

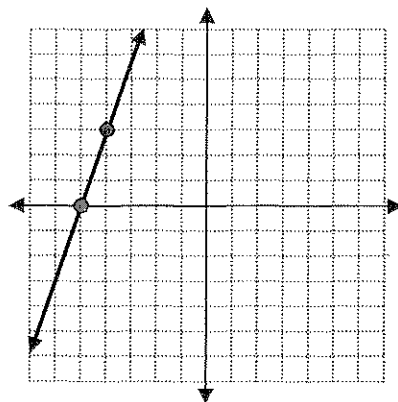


Slope = 3

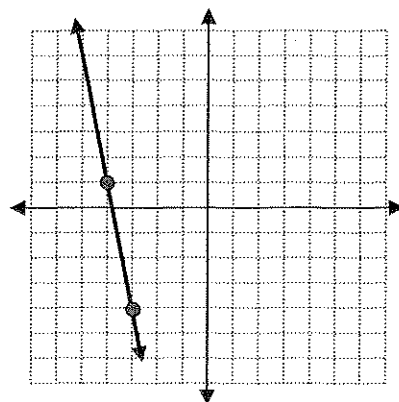


Slope =  $\frac{1}{5}$

$$y = \frac{1}{2}x - 3$$

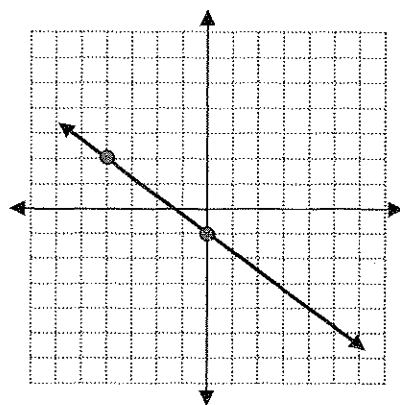


Slope = 3

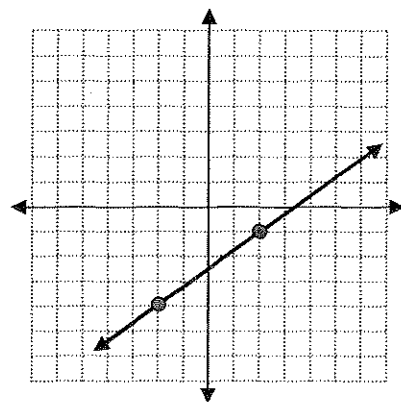


Slope = -5

$$y = -2x + 6$$

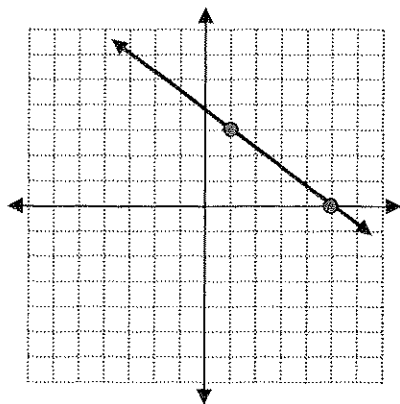


$$\text{Slope} = -\frac{3}{4}$$

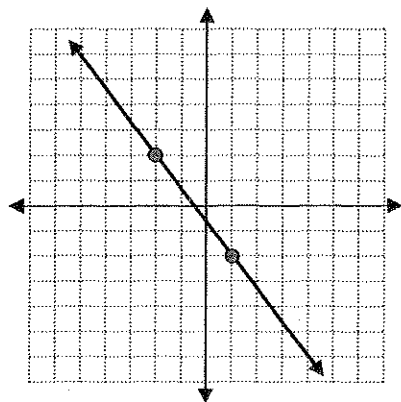


$$\text{Slope} = \frac{3}{4}$$

$$y = \frac{5}{2}x - 11$$



$$\text{Slope} = -\frac{3}{4}$$



$$\text{Slope} = -\frac{4}{3}$$

$$y = -\frac{2}{5}x + 4$$